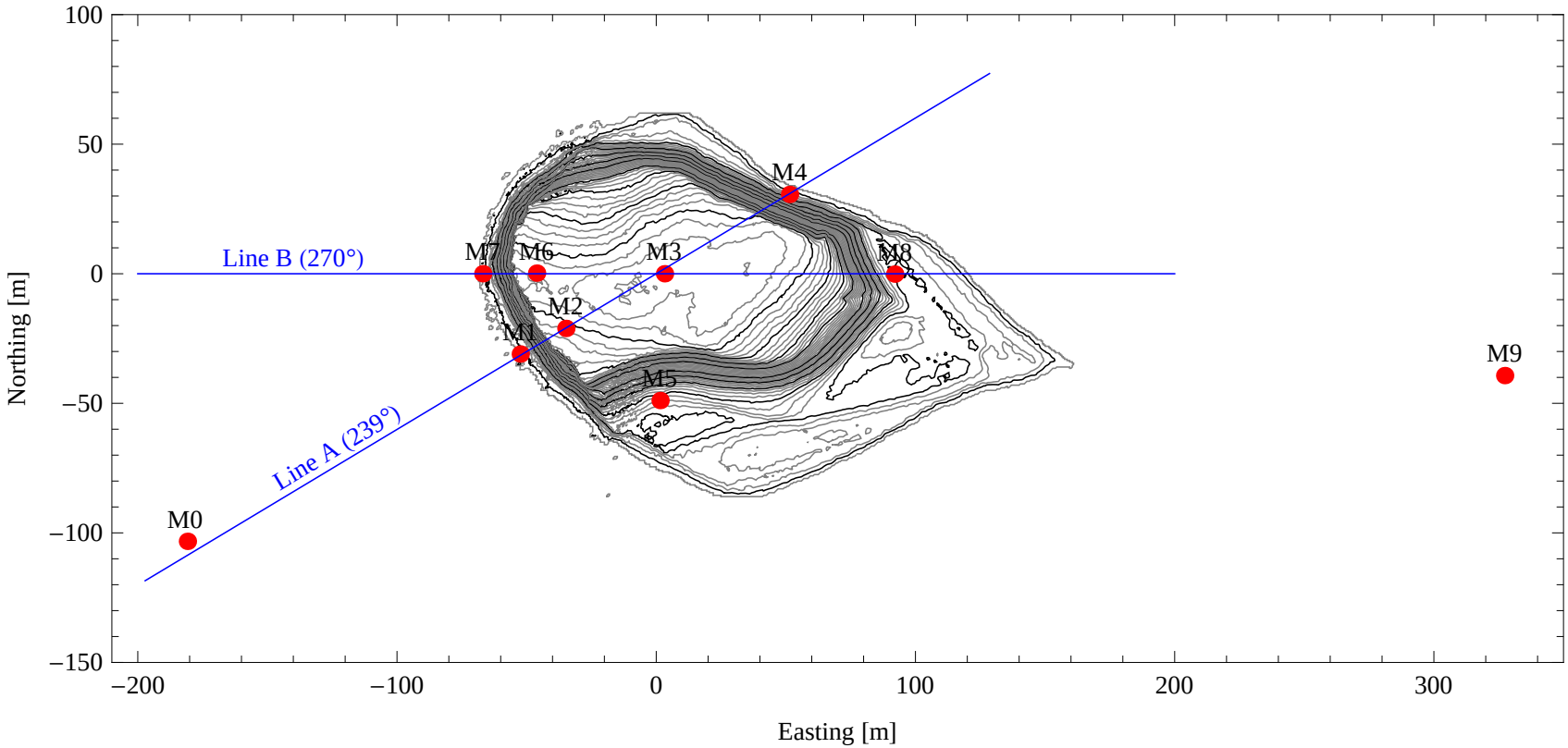
Atmospheric boundary layer and complex terrain

Jakob Mann

February 3, 2011 – DSF Flow center steering committee meeting, DTU, Lyngby

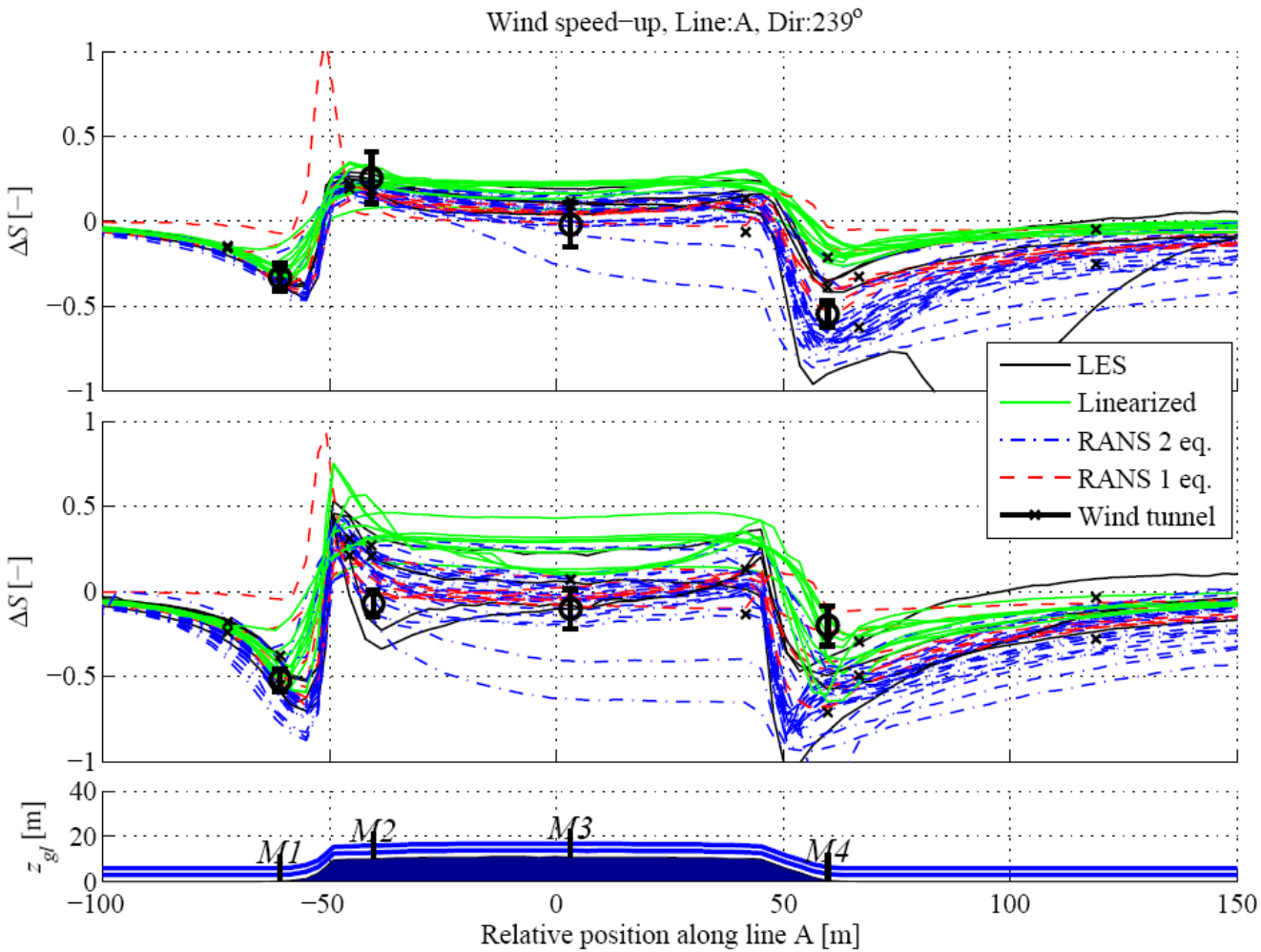
Documentation of the Bolund Experiment

The Bolund Experiment, Part I: Flow over a steep, three-dimensional hill, *BLM*, J. Berg, J. Mann, A. Bechmann, M. S. Courtney, H. E. Jørgensen



Documentation of the Bolund Experiment

The Bolund Experiment, Part II: Blind Comparison of Micro-Scale Flow Models, *BLM*,A. Bechmann · N. N. Sørensen · J. Berg · J. Mann · P-E Rethore



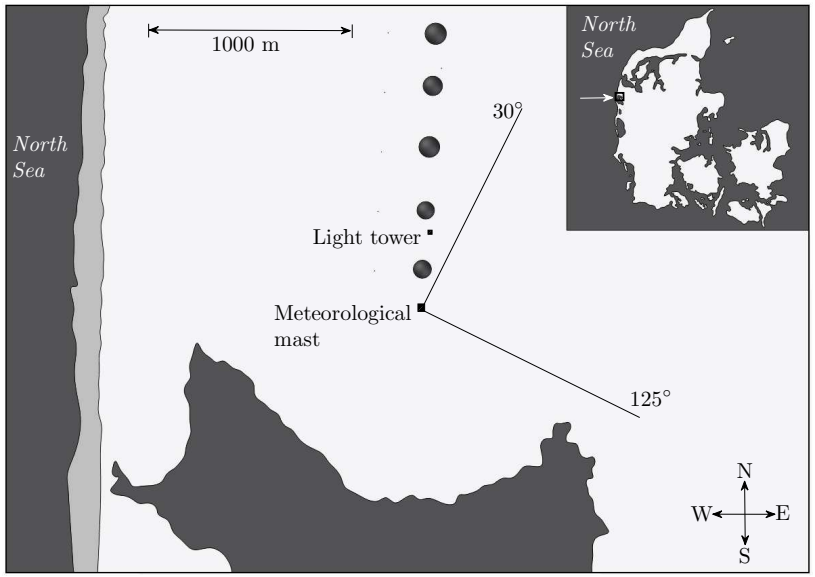
Benakanahalli Experiment Analysis

- 80 m masts in a South Indian hilly landscape
- Report available
- Weak winds

Spectra and length scales

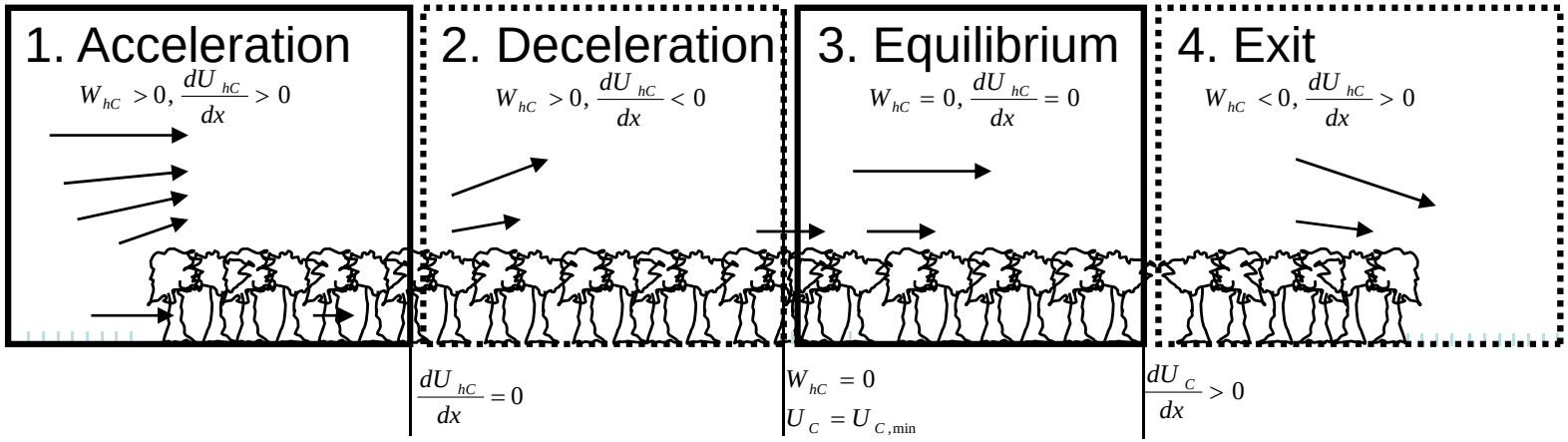
On the length scale of the wind profile, *QJRMS* 2010, A. Peña, S. Gryning and J. Mann

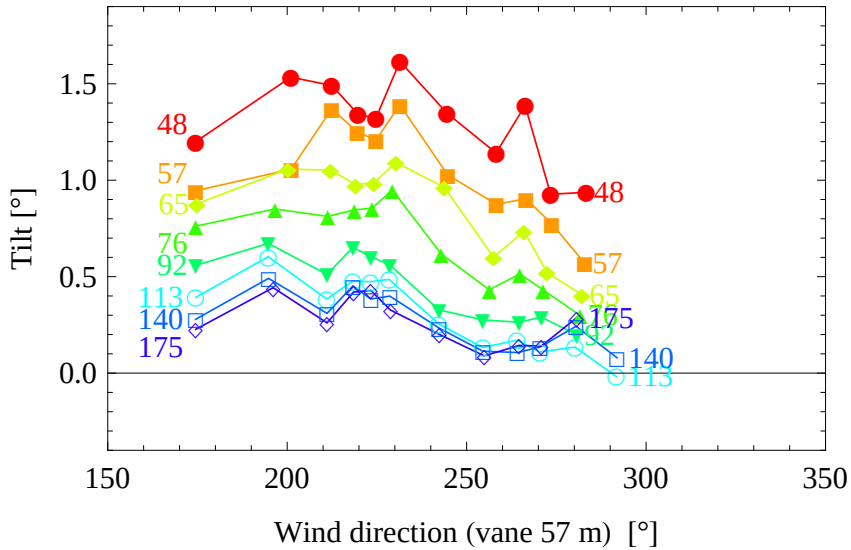
- Neutral spectral tensor model fitted to Høvsøre data with varying stability
- Mixing lengths and spectral length scales compare well
- Models of the mixing lengths height dependence tested



Flow tilt angles

Flow tilt angles near forest edges – Part 1: Sonic anemometry, Part 2: Lidar anemometry, *BioGeoSciences* 2010 E. Dellwik, J. Mann, F. Bingöl and K. S. Larsen





EERA workshop on wind conditions

26-28 January 2011, Porto, Portugal

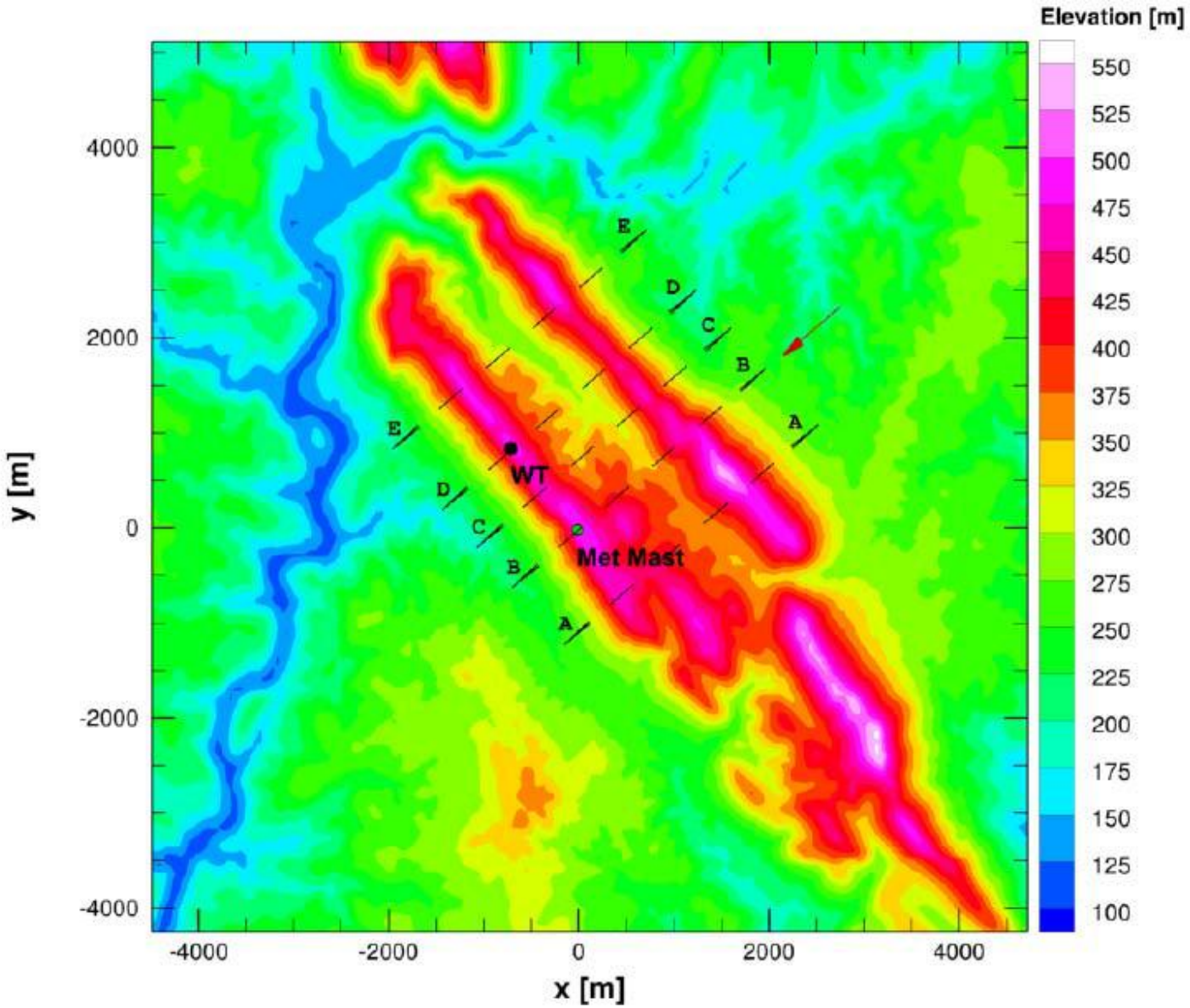
Main points of the workshop

- *A detailed design of a comprehensive set of field-experimental activities to provide a public set of reference data for use by industry and research organizations.*
- Research into improvement and optimization of the "model chain" (from global to local scale).
- Based on the above points detailing of a robust methodology for establishment of an improved European Wind Resource Mapping ("European-Wind-Atlas-II") including time variations statistics and uncertainty measures.

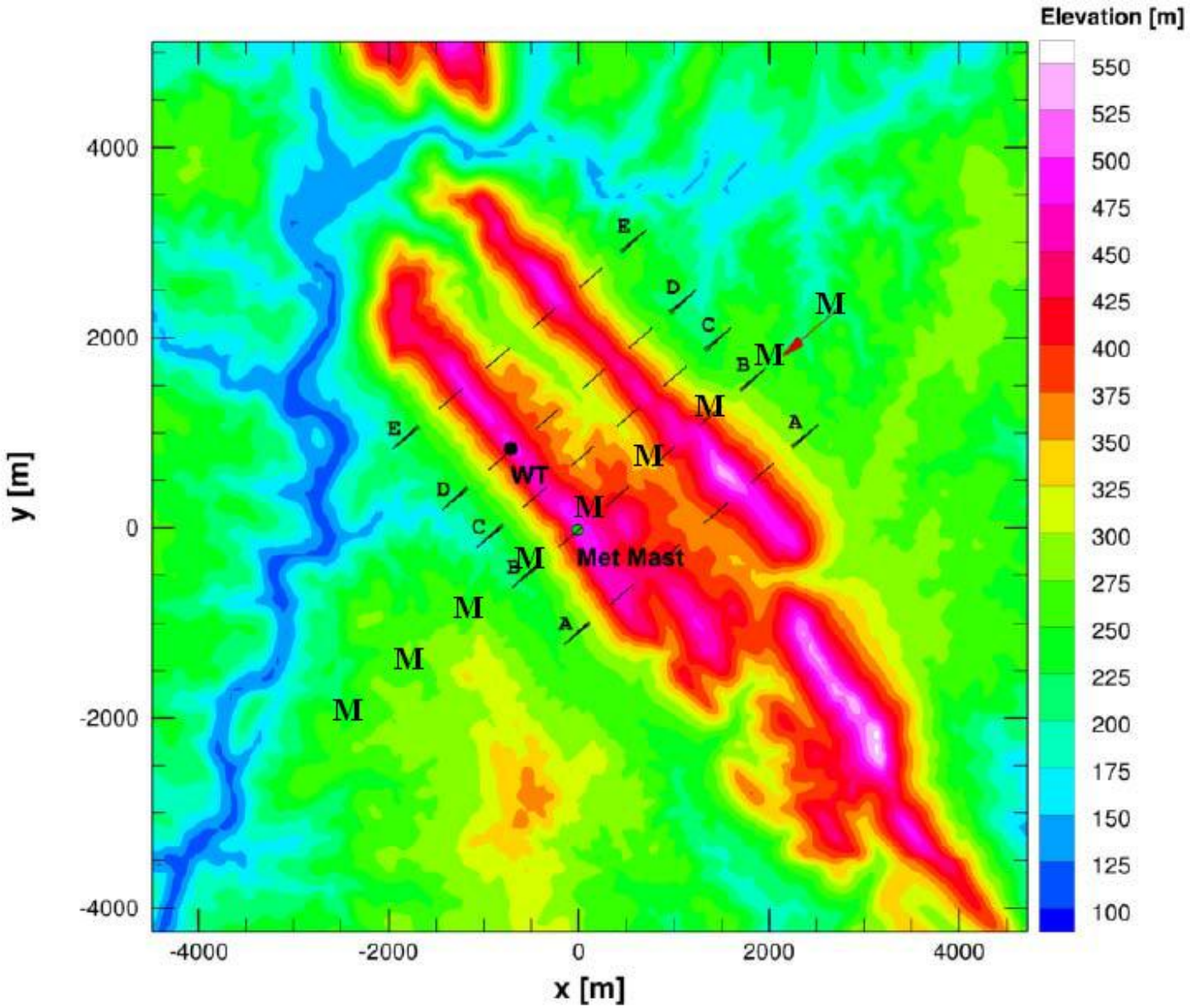
EERA experiment: Proposed Portuguese site

EERA experiment: Proposed Portuguese site

EERA experiment: Proposed layout



EERA experiment: Proposed layout



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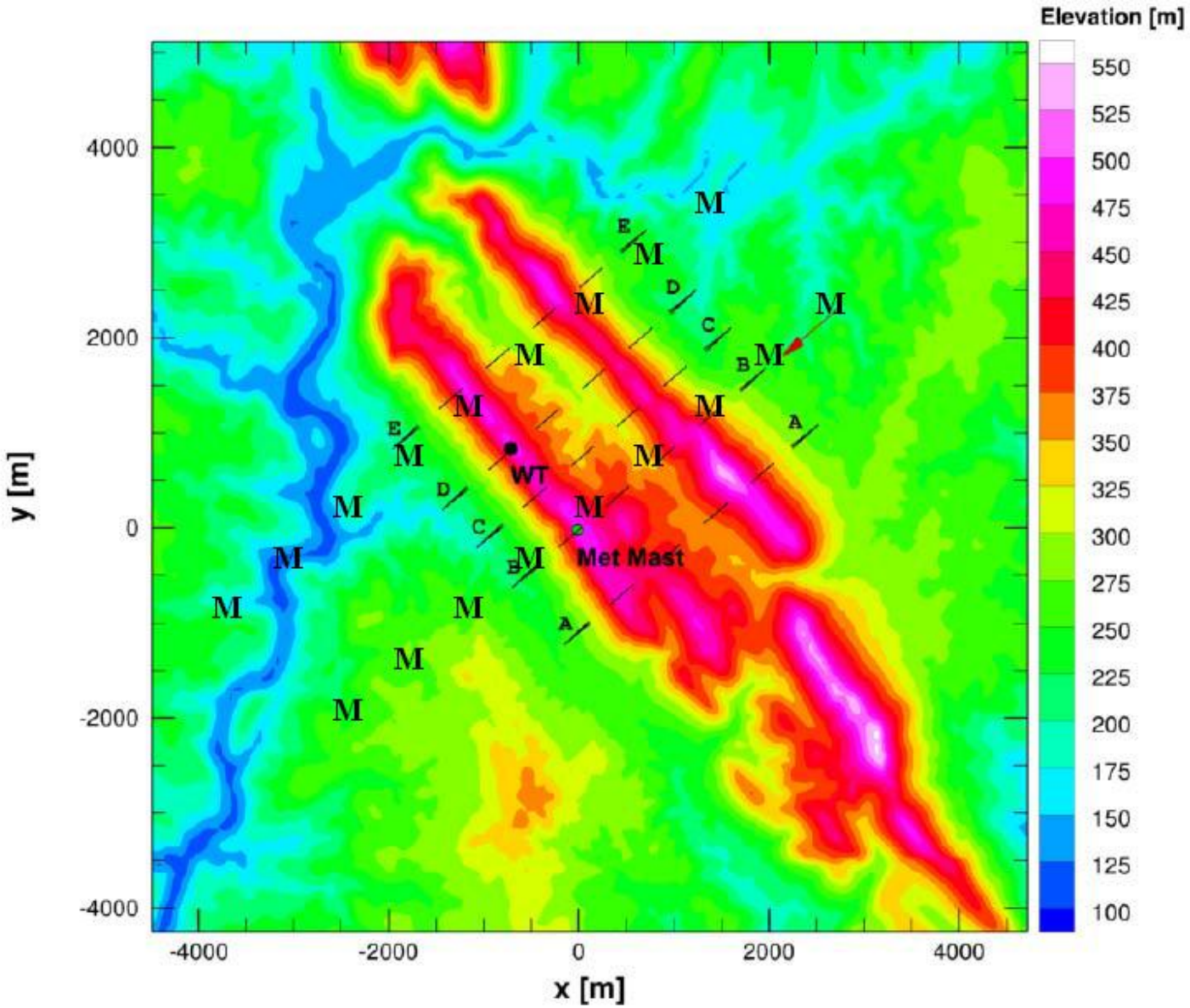
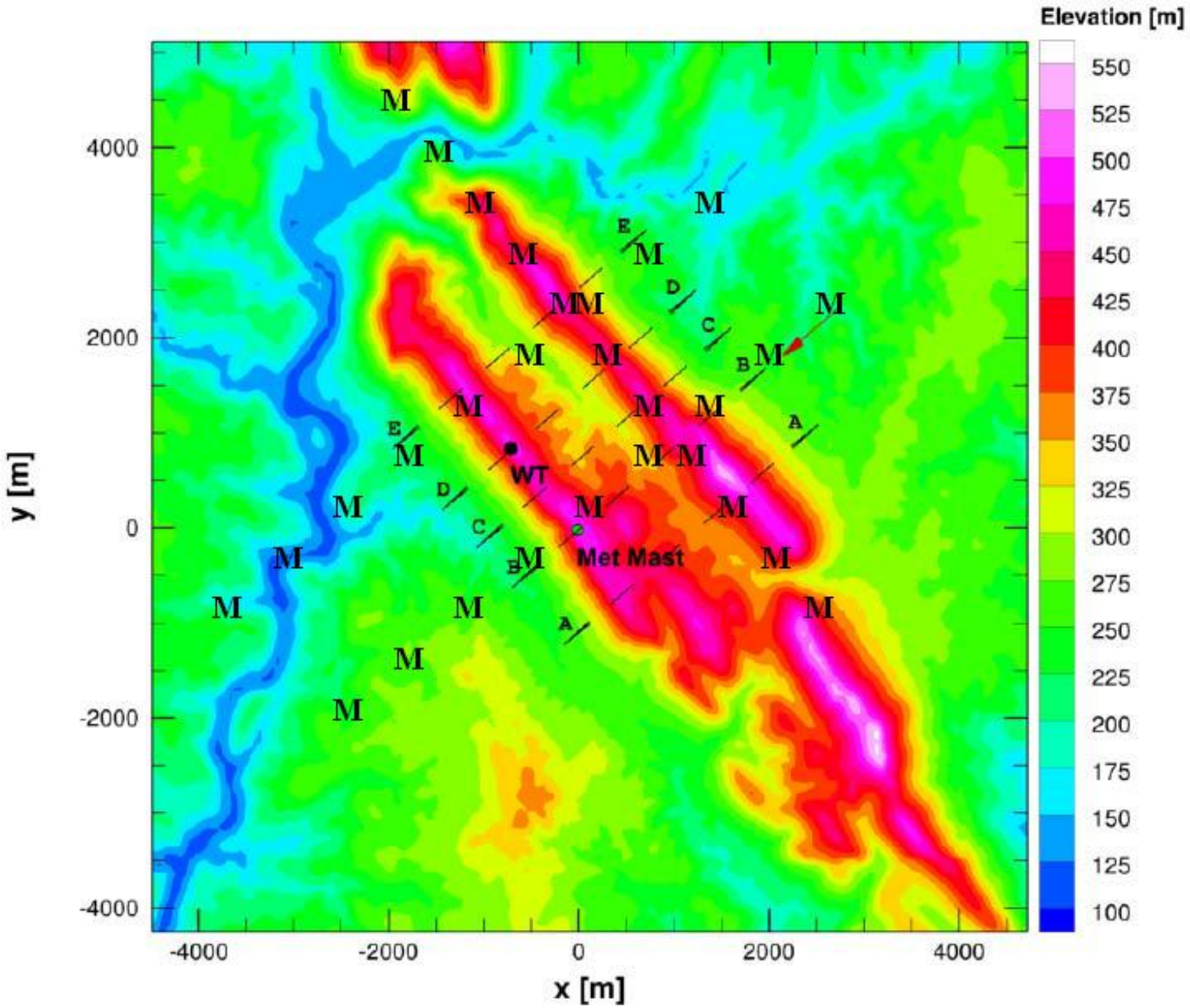


EERA experiment: Proposed layout



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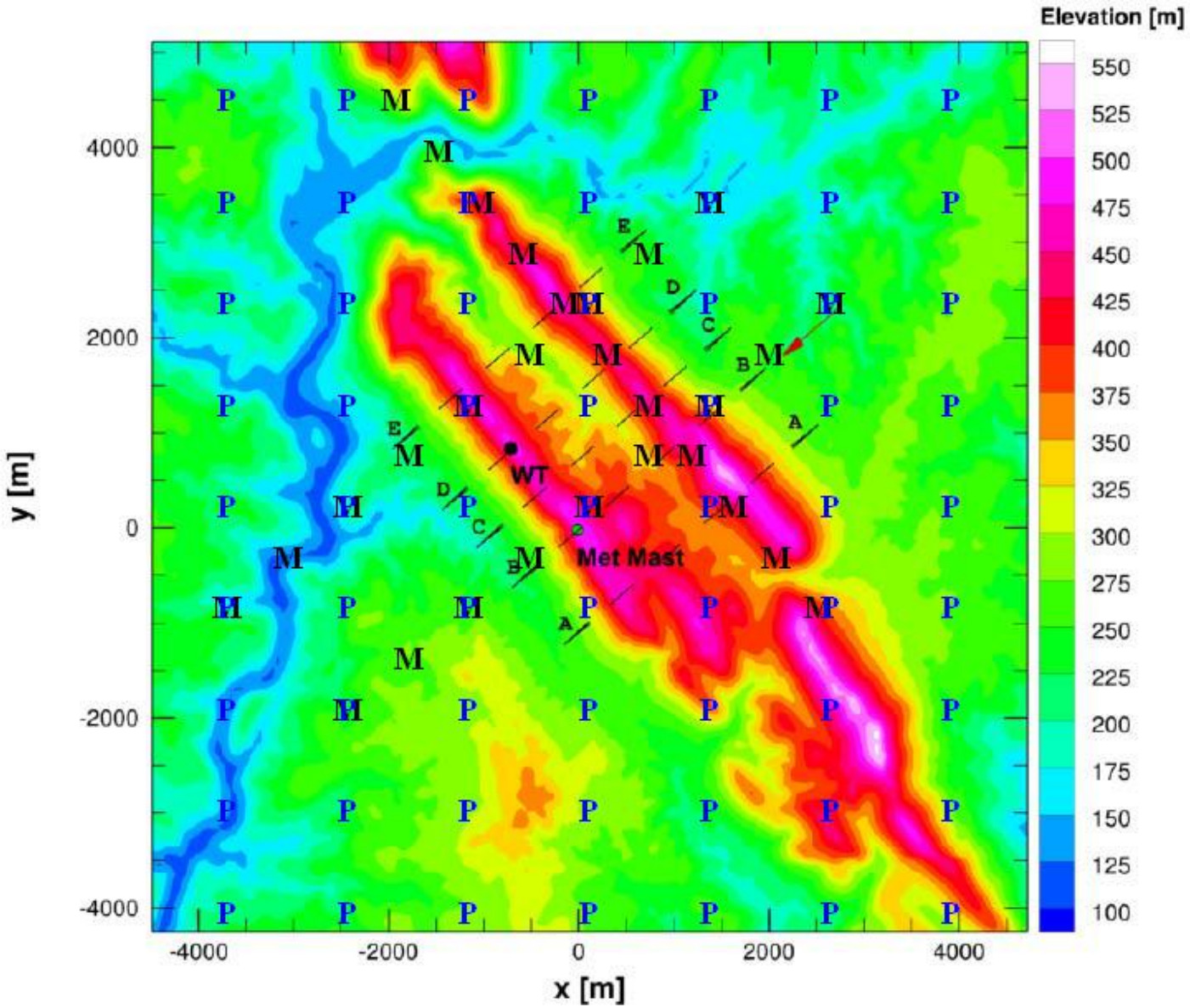
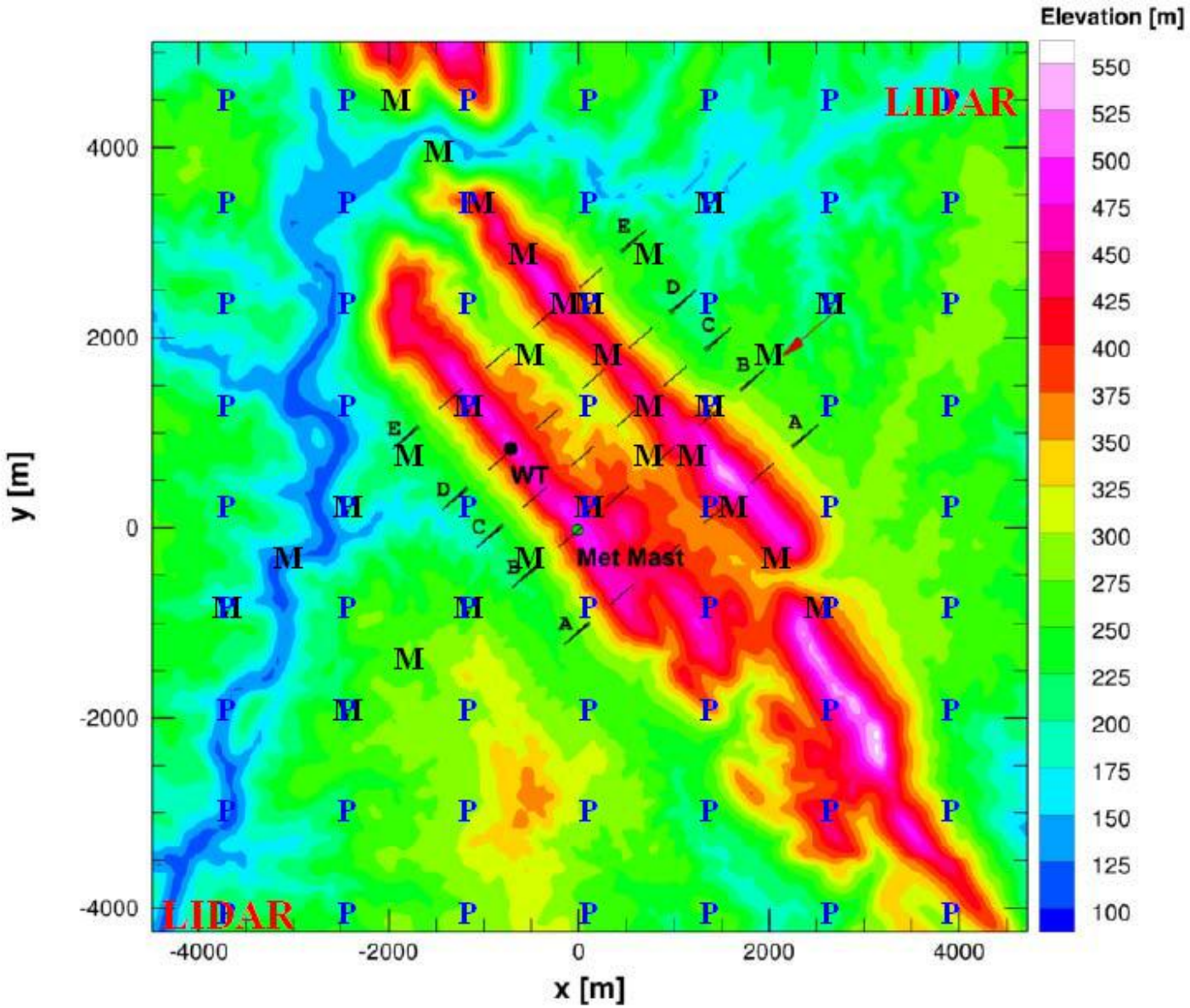


EERA experiment: Proposed layout



Work package 4

Siting in Forested and Complex Terrain

4	M18	Validation of complex terrain flow models using data from the Bolund experiment and the Vestas India site.	6
4	M19	Beta version of terrain flow solver available to industry partner Vestas.	7
4	M20	Beta version of forest model available to industry partner Vestas.	12
4	M21	Forest model Version-1.0 using parametrization from SCADIS.	24
4	M22	Terrain flow model that includes atmospheric stratification.	40
4	M23	Parametric study of the mutual turbine/terrain influence. (Using Actuator Disk/Line, both with RANS and LES)	44

Work package 5

Atmospheric Boundary Layers

5	M24	Implementation and validation of stability and boundary layer temperature inversion in Ellip-Sys3D.	44
5	M25	Development and verification of a model of the spatial structure of atmospheric turbulence under influence of stratification.	48
5	M26	Parametric study of stratified boundary layer from Horns Rev and Høvsøre.	60
5	M27	Assessment of stratification impacts on rotor performance.	70

Flow over and around forests

- Implementation and testing of SCADIS canopy code in EllipSys3D (Andrey Sogachev, NN + AED)
- Revise paper on the Falster forest edge experiment (Ebba Dellwik, Ferhat Bingöl)
- Analyze turbulence from the Falster experiment (Ebba + Jakob + Andrey)
- Analyze and model flow over Østerild in more detail (Ebba + Andreas Bechmann + PhD student starting 2011)

Stability and complex terrain

- Benakanahalli potentially useful for CFD comparison
- Bolund marginally useful
- PhD student (Tilman Koblitz, funded by WAUDIT) work on atmospheric stability in EllipSys3D

Spectral tensor models

Flat terrain

- Extent the RDT theory to include stability (Mark Kelly, Jakob Mann, PhD student Abhijit Chougule)
- Inclusion of the Coriolis force.
- Analysis of Høvsøre data in terms of cross-spectra, coherences etc

Fast, linearized flow models

- Finalize and document wind farm model (Søren Ott, J. Berg)
- Extent to forest canopies
- Exploration of non-linear models through iteration of the linearized models (S. Ott)